**Sec 3 Express Physics Mid Year exam 2011**

Section A

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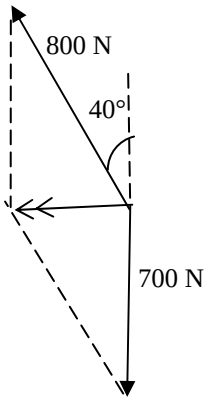
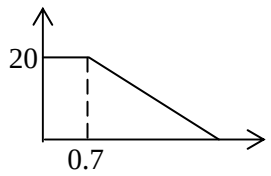
|---|---|---|---|---|---|
| 1 | **C** | 11 | **A** | 21 | **D** |
| 2 | **A** | 12 | **B** | 22 | **A** |
| 3 | **B** | 13 | **A** | 23 | **C** |
| 4 | **B** | 14 | **B** | 24 | **C** |
| 5 | **A** | 15 | **C** | 25 | **B** |
| 6 | **B** | 16 | **B** | 26 | **B** |
| 7 | **A** | 17 | **C** | 27 | **D** |
| 8 | **B** | 18 | **A** | 28 | **C** |
| 9 | **D** | 19 | **B** | 29 | **B** |
| 10 | **A** | 20 | **C** | 30 | **C** |

Section B

| Questions | Suggested answers | Marks |
|---|---|---|
| 1(a) |  <br>Scale 1 cm : 100 N and 2 given forces correctly drawn<br>Correct arrow of resultant force<br>Resultant force = 522 ± 10 N<br>Acceptable range: (512 to 532 N)<br>Direction =60° (±1°) from 800 N force<br>or 80° (±1°) from 700 N force | B1<br>B1 (if arrow is wrong, 0 mark)<br>A1<br>A1 |
| (b) | a = 520 / 25<br>= 20.8 m s$^{-2}$ | M1<br>A1 (ecf fr. (a)) |
| 2(a)(i) | Reaction time = 7/10 = 0.7 s or 14.0/20 = 0.7 s | M1, A1 |
| (ii) | X = 30 x 0.7 = 21 m | A1 |
| 2(b)(i) |  <br>correct shape<br>label 20 ms$^{-1}$ & 0.7 s<br>(allow ecf 2(a)(i)) | B1<br>B1 |
| (ii) | ½ x t x 20 = 30.0<br>t = 3.0 s | M1 (allow ecf from (b)(i))<br>A1 |

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| 3 (a) (i) | Mass of an object is the amount of substance in it. | B1 |
| (ii) | Gravitational field strength is the gravitational force per unit mass | B1 |
| (b) (i) | Density = 544 / 64<br>= 8.5 g $cm^{-3}$ | M1<br>A1 |
| (ii) | Density of P = 51.2 / 64 = 0.80 g $cm^{-3}$ | M0, A1 |
| (iii) | Liquid P on top, water, liquid Q at the bottom | A1(ecf fr. b(i) &(ii)) |
| 4(a) | Moment of weight of bridge = 2000 x 3.0<br>= 6000 Nm | M1<br>A1 |
| (b) | Moment of weight of man = 750 x 4 = 3000 Nm | M0, A1 |
| (c) | Taking moments about B,<br>ACW = CW<br>$F_A$ x 6 = 6000 + 3000<br>$F_A$ = 9000 / 6 = 1500 N | <br><br>M1<br>A1 (ecf fr. (a) & (b)) |
| (d) | Total upward forces = total downward forces<br>1500 + $F_B$ = 2000 + 750<br>$F_B$ = 1250N<br><br>Or taking moments about A and find $F_B$<br>$F_B$ x 6 = 6000 + (750 x 2)<br>$F_B$ = 7500 / 6 = 1250 N | <br>M1<br>A1 (allow ecf fr. (c)) |
| 5(a)(i) | 0 cm Hg | A1 |
| (ii) | 86 – 56 = 30 cm Hg | A1 |
| (iii) | 86 – 10 = 76 cm Hg | A1 |
| (iv) | 76 cm Hg | A1 |
| (b) | Pressure = 13.6 x $10^3$ x 10 x 0.86<br>= 1.17 x $10^5$ Pa | M1<br>A1 |
| (c) | Level of mercury increases | A1 |
| 6(a) | Will increase, extra fuel needed to do work against gravity (car gains GPE) and to do work against friction. | B1 |
| (b)(i) | Correct direction and labelled ↓ $F_g$ | A1 |
| (ii) | Correct direction and labelled ↙ $F_f$ | A1 |
| (c)(i) | W = F x d = 200 x 160<br>= 32000 J | M1<br>A1 |
| (ii) | W = mgh + 32000<br>= 640 x 10 x 10 + 32000<br>= 64000 + 32000<br>= 96000 J | M1 (ecf fr. c(i))<br><br><br>A1 |

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| 7(a)(i) | $a = (v - u) / t$<br>$10 = (v - 0) / 2.5$<br>$v = 25 \text{ m s}^{-1}$ | <br>M1<br>A1 |
| (ii) | distance = ½ x 2.5 x 25<br>= 31.25 m = 31.3 m (3 sf)<br><br>Or loss in GPE = gain in KE<br>$mgh = ½ mv^2$<br>$h = ½ v^2/g = ½ \times 25^2 /10$<br>= 31.25 m = 31.3 m (3 sf) | M1<br>A1 (ecf fr. a(i))<br><br><br>M1<br>A1 (ecf fr. a(i)) |
| (b) | The presence of air resistance retards motion and causes a smaller resultant force and acceleration.<br>Or energy loss as heat energy due to air resistance. Final KE is lesser and hence speed reached is less. | B1 |
| (c) | As the man falls further, the <u>tension in the cord increases</u>. This tension opposes the downward gravitational force acting on the man. The <u>net downward force decreases</u> and so the acceleration decreases.<br><br><u>Note</u><br>Energy converted to EPE, so (KE + GPE) decreases, KE and v decreases – cannot conclude – cannot accept | B1<br><br>B1<br><br><br><br><br>B1 |
| (d)(i) | When the <u>tension is equal to the weight of the man</u>, the <u>net force acting on the man is zero</u>. Hence the acceleration is zero. | <br><br>M1, A1 |
| (ii) | tension = mg = 80 x 10 = 800 N | |
| 8 (a)(i) | The point where the whole weight of a body seems to act. | B1 |
| (ii) | The turning effect of a force about a certain point. It is the product of the force and the perpendicular distance from the line of action of the force. | B1 |
| (b) | Stable equilibrium,<br>A slight displacement raises the CG but if the displacement/ force is removed, CG goes back to its original position. | B1<br>B1 |
| (c)(i) | 0.50 x 10 = 5.0 N cm | M1, A1 |
| (ii) | 0.80 x d = 5.0<br>d = 6.25 cm<br>10 – 6.25 = 3.75 cm from R | M1<br>A1 (ecf fr. b(ii))<br>A1 |
| (iii) | Between C and N | B1 |

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| 9(a)(i) | Energy cannot be created or destroyed but only changes from one form into another. | B1 |
| (ii) | Before it is dropped, GPE max, KE is zero. During fall, KE increases and GPE decreases. On hitting baseplate, GPE is zero while KE is max. | B1 |
| (b)(i) | KE = ½ x 1600 x $9^2$ = 6.48 x $10^4$ J | M1, A1 |
| (ii) | Initial GPE = 6.48 x $10^4$ J | A1 (ecf fr. b(i)) |
| (iii) | GPE = mgh = 6.48 x $10^4$ J<br>h = 6.48 x $10^4$ / (1600 x 10)<br>= 4.05 m | M1<br>A1 (ecf fr. b(ii)) |
| (c)(i) | output power = 6.48 x $10^4$ / 3.0 x 60 = 360 W | M1, A1 (ecf fr. b(iii)) |
| (ii) | use a larger mass (or weight) of hammer, larger hammer not acceptable<br>or drop hammer from a large height. | B1 |